

STUDENT SCOPE USING NI USB DATA ACQUISITION

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Abstract

The StudentScope is a software oscilloscope specifically designed to work with the National Instruments Low Cost USB data acquisition devices. The StudentScope was created in LabVIEW. The front panel controls are modeled after those typically found on a traditional benchtop oscilloscope.

Student Scope Using NI USB Data Acquisition

1 LabVIEW Student Scope Using the NI USB Data Acquisition

The StudentScope is a software oscilloscope specifically designed to work with the National Instruments USB-6009 data acquisition device¹. To simulate the functionality of a scope, the StudentScope acquires analog input data across two channels and then searches for a user-specified trigger level. This allows periodic waveforms to be lined up and displayed as standing waves. Controls to scale signals, apply vertical offsets, adjust the timebase, and measure phase offsets are all meant to function similarly to a benchtop oscilloscope. Several expanded features are also available, including a option to log data to an Excel-compatible spreadsheet file or to export a screenshot to a printable HTML report.

1.1 Download the StudentScope

The StudentScope source code can be downloaded here: StudentScope Source (1.0)². The StudentScope source requires: LabVIEW³ 8.0 or later, and NI DAQmx⁴ 8.0 or later.

The StudentScope stand-alone executable can be downloaded here: StudentScope.exe (1.0)⁵. The StudentScope executable requires: LabVIEW RunTime Engine 8.0⁶, and NI DAQmx⁷ 8.0 or later. You must extract all files from the zip distribution before attempting to use the source or executable versions of this application.

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¹ <http://digital.ni.com/express.nsf/bycode/ex4v7m>

² [studentscope.zip](#)

³ <http://digital.ni.com/demo.nsf/websearch/14f9ce475127ade786256ac60070926c>

⁴ <http://digital.ni.com/softlib.nsf/websearch/11D505B7B355EBD68625722D006A6B97>

⁵ [studentscope_exe.zip](#)

⁶ ftp://ftp.ni.com/pub/devzone/tut/cnx_lv8_runtime.exe

⁷ <http://digital.ni.com/softlib.nsf/websearch/11D505B7B355EBD68625722D006A6B97>

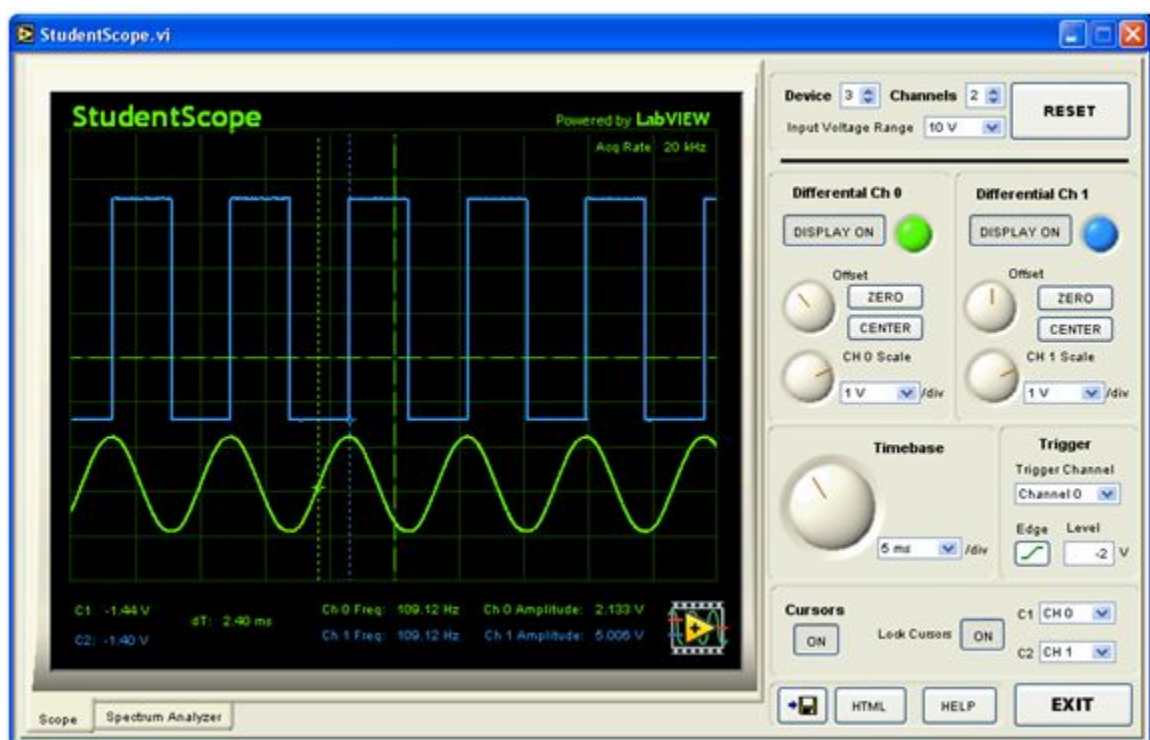


Figure 1: StudentScope Front Panel

1.2 Getting Started

First, be sure you have the LabVIEW Run-Time Engine version 8.0 and the DAQmx driver version 8.0 or later installed under the default installation options. Both can be downloaded free of charge from ni.com. The installer included with the Student Scope includes the LabVIEW Run-Time Engine, but DAQmx must be downloaded separately. Next, connect your National Instruments USB-6009⁸ to your PC. Windows should detect the device and configure the appropriate driver. If this is the first time that a USB-6009 device is installed on your computer, you might be prompted to install a USB-6xxx Firmware Loader. Please complete the Windows Hardware Wizard prompts to completely install this device.

To run the StudentScope, you will need to determine the device number of your USB-6009, which is how the hardware is identified by the scope software. Find this by opening National Instruments Measurement and Automation Explorer (MAX). In MAX, expand Devices and Interfaces. Then expand NI-DAQmx Devices. If the DAQmx driver is installed properly, and the USB-6009 is connected, you will see an item such as USB-6009: "Dev1" where Dev1 indicates device 1. Make a note of the device number.

When you run the StudentScope, you will need to select the correct device number. If the wrong device number is selected, you will receive an error message. To fix this, be sure the USB-6009 is plugged in, select the correct device number, and press the reset button.

1.3 Hardware Connections

Connect input signals to differential channels 0 and 1 on the USB-6009. Terminals 2 and 3 on the 6009 correspond to the positive and negative inputs for differential channel 0. Terminals 5 and 6 the 6009 correspond to the positive and negative inputs for differential channel 1. For more information on terminals and connections, consult the help manual for the device.

1.4 Controls

The following controls on the StudentScope front panel are used to control the behavior of the scope. The controls are modeled after a traditional benchtop oscilloscope.

- **Device:** Specifies the Device Number of the 6009, which uniquely identifies the hardware. This number can be found in Measurement and Automation Explorer (MAX). If you adjust this input, you will have to press reset for the changes to take effect.
- **Channels:** Specifies the number of channels to scan. By acquiring only a single channel of data, twice the sampling rate can be achieved over acquiring two channels of data. If you adjust this input, you will have to press reset for the changes to take effect.
- **Input Voltage Range:** Sets the internal programmable gain amplifier on the 6009. This applies an appropriate analog gain to the signal prior to digitization. For best results, choose the smallest range setting that completely encapsulates the expected signal. If you adjust this input, you will have to press reset for the changes to take effect.
- **Reset:** If Device, Channels, or Input Voltage Range values are changed, the StudentScope needs to be reset for the changes to take effect.
- **Display On:** Toggles the visibility of each channel's trace. Note: This does not change whether or not the data is actually being acquired by the USB-6009; it merely allows the user to turn on or off the display of that data.

⁸<http://digital.ni.com/express.nsf/bycode/ex4v7m>

- Offset: Adjusts the vertical position of the trace on the display by adding or subtracting a voltage offset.
- Zero: Removes any offsets added with the Offset knob.
- Center: Automatically adjusts the Offset knob so that the waveform is centered vertically on the display.
- Scale: Sets the Volts per division along the vertical axis in order to "zoom" vertically.
- Timebase: Sets the time per division along the horizontal axis in order to "zoom" horizontally. This does not change the rate of acquisition of the hardware.
- Trigger Channel: Specifies which channel will generate the trigger.
- Edge: Toggles between triggering off of a rising or falling edge of the signal.
- Level: Specifies the voltage level at which a trigger will be generated. Note: If the level is never crossed by the periodic signal, the trigger will not work properly and the waveform will not display correctly. Also, the trigger is defined in software, and will only correctly display periodic signals with a period of less than 1/8 second.
- Cursors (On/Off): Toggles display of the cursors on or off.
- Lock Cursors: Toggles whether cursors are free-floating or locked to a channel trace. If cursors are free floating, the voltage level at each cursor will not be displayed.
- C1: If Lock Cursors is toggle on, this selects the channel to which Cursor 1 is locked.
- C2: If Lock Cursors is toggle on, this selects the channel to which Cursor 2 is locked.
- X Axis Scroll: Adjusts the center frequency of the Spectrum Analyzer. Page Up and Page Down can fine tune this control left and right.
- X Axis Zoom: Adjusts the min and max range of the X axis of the Spectrum Analyzer.